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TI Copper alloy for semiconductor lead frame
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AB The Cu alloy contains Zn 5-35, Sn 0.1-3, P 0.005-0.5, and Si, Cr, Ti, Zr, Co, Mn, Al, and/or Mg 0.01-1% and has a crystal grain size of 5-35 μm. The alloy optionally contains Pb, Be, Se, Te, Ca, Sr, and/or misch metal 0.001-0.5%. The alloy has high strength, elec. conductivity, bendability, punchability, and resistance to stress corrosion cracking.

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[Claim(s)]

[Claim 1] For Sn P 0.1 - 3wt% 5 - 35wt% 0.005 to 0.5%, [Zn] The copper alloy for semiconductor lead frames characterized by being the copper alloy which consists of one sort or as unescapable two or more sorts at the total the impurity as a 0.01-1wt% implication and Remainder Cu chosen from Si, Cr, Ti, Zr, Co, Mn, and the group that consists of aluminum and Mg, and a grain size number being 5-35 micrometers.

[Claim 2] For Sn P 0.1 - 3wt% 5 - 35wt% 0.005 to 0.5%, [Zn] One sort chosen from Si, Cr, Ti, Zr, Co, Mn, and the group that consists of aluminum and Mg, or two sorts or more by the total A 0.01-1wt% implication, One sort chosen from the group which consists of Pb, Bi, Se, Te, Ca, Sr, and a misch metal, or two sorts or more by the total Furthermore, a 0.001-0.5wt% implication, The copper alloy for semiconductor lead frames characterized by being the copper alloy which consists of the remainder Cu and an unescapable impurity, and a grain size number being 5-35 micrometers.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the copper alloy used for the lead material for electronic electrical machinery and apparatus, terminal material, etc., and relates to the suitable copper alloy for the lead material for semiconductor devices, such as IC, (lead frame material) especially.

[0002]

[Description of the Prior Art] Conventionally as the lead frame material of Semiconductor Division, and terminal material, copper system material, such as a Cu-Sn system excellent in others, electrical conductivity, and thermal conductivity and a Cu-Fe system, is also used widely. [material / iron system]

[0003] By the way, since noble-metals metal plating (Ag etc.) besides hardness, a heat-resisting property, electrical conductivity, and thermal conductivity and solder metal plating are performed, characteristics, such

as metal-plating nature, soldered joint nature, and surface smoothness, are thought as important by said lead frame material. Moreover, in order to secure the dimensional accuracy at the time of molding a lead frame from ** and a board, molding processability, such as good etching nature or punching quality, is required, and it is important that it is also still more practical in respect of a price.

[0004] And these characteristics demanded are becoming severer corresponding to high integration of Semiconductor Division in recent years, a miniaturization, advanced features, and low-cost-izing. In particular, multi-pin-izing of a lead frame, a miniaturization, thinning, etc. progress, and in order to secure advanced dimensional accuracy, the material which has good molding processability is called for strongly in recent years.

[0005] As a molding processing method of a lead frame, a blanking method is in use and it is technological innovation in recent years, Although it is small, the matrix form lead frame processed into many sequences comes to be manufactured by blanking, and the lead frame of multi pin or fine pitch and the number of pins are gaining in the importance of the punching quality of material especially. Moreover, blanking is the advantageous processing method also in cost.

[0006]

[Problem(s) to be Solved by the Invention] Although an above-mentioned Cu-Sn system alloy and an above-mentioned Cu-Fe system alloy are widely used as lead frame material, there is a problem that punching quality is a little inferior. The alloy which uses Cu-Zn alloy excellent in punching quality as a base as the remedy was indicated by JP,H1-162737,A and JP,H5-36878,A.

[0007] [however, Cu-Zn alloy indicated by former JP,H1-162737,A] It is easy to generate stress corrosion cracking, and there is a problem that punching quality sufficient in the multi pin lead frame of 100 or more pins is not acquired. Although the Cu-Zn system alloy indicated by latter JP,H5-36878,A performs nickel/Pd metal plating to the surface and stress corrosion cracking is improved, when bending of the lead is carried out, there is a problem that a crack goes into nickel metal-plating layer, and stress corrosion cracking arises.

[0008] This invention is made under such a situation and aims at offering the copper alloy for semiconductor lead frames excellent in hardness, conductivity, bending nature, punching quality, stress-corrosion-cracking-proof nature, manufacture workability, etc.

[0009]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the 1st invention for Zn Sn 5 - 35wt% 0.1 - 3wt%, P 0.005 to 0.5%, Si, Cr, Ti, Zr, Co, Mn, It is the copper alloy which consists of one sort or as unescapable two or more sorts at the total the impurity as a 0.01-1wt% implication and Remainder Cu chosen from the group which consists of aluminum and Mg, and the copper alloy for semiconductor lead frames characterized by a grain size number being 5-35 micrometers is offered.

[0010] The 2nd invention for Zn Sn 5 - 35wt% Moreover, 0.1 - 3wt%, P 0.005 to 0.5%, Si, Cr, Ti, Zr, Co, Mn, One sort chosen from the group which consists of aluminum and Mg, or two sorts or more by the total A 0.01-1wt% implication, One sort chosen from the group which consists of Pb, Bi, Se, Te, Ca, Sr, and a misch metal, or two sorts or more by the total Furthermore, a 0.001-0.5wt% implication, It is the copper alloy which consists of the remainder Cu and an unescapable impurity, and the copper alloy for semiconductor lead frames characterized by a grain size number being 5-35 micrometers is offered.

[0011] A misch metal is the alloy which makes Ce and La a principal component, and it usually consists of

45 to 50 weight % of Ce(s), 20 to 40 weight % of La(s), the remainder, and other rare earth elements (Nd, Sm, Pr, etc.).

[0012]

[Embodiment of the Invention] The copper alloy concerning this invention uses a Cu-Zn system alloy as a base, and improves adding a proper quantity of Sn(s) for the stress corrosion cracking which is the fault, and by controlling a grain size number proper. In addition, Sn contributes to the improvement in hardness, and rationalization of a grain size number contributes to the improvement of bending nature.

[0013] In the copper alloy concerning this invention, Zn lessens extremely the development of Bali at the time of blanking, and a twist of a lead, and shows the operation of raising punching quality. The Reason for specifying the content of Zn to 5 - 35wt% is for a parent phase to appear and for cold working nature to get worse less than [5wt%], if the addition effect is not fully acquired but exceeds 35wt%. The desirable content of Zn is 6 - 30wt%.

[0014] Sn contributes to the improvement of the improvement in hardness, and stress-corrosion-cracking-proof nature. The Reason for specifying the content to 0.1 - 3wt% is for conductivity and hot working nature to fall less than [0.1wt%], if the addition effect is not fully acquired but exceeds 3wt%.

[0015] In the copper alloy concerning this invention, the Reason for specifying a grain size number to 5-35 micrometers is because the improvement effect of the bending nature and correspondence power corrosion cracking nature is not fully acquired, even if a grain size number exceeds 35 micrometers of at least less than 5 micrometers. A desirable grain size number is 5-20 micrometers. In addition, in the copper alloy concerning this invention, a grain size number is determined according to JIS-H0501.

[0016] In the copper alloy concerning this invention, Si, Cr, Ti, Co, Mn, and aluminum and Mg improve punching quality by forming P and a compound and raising alloy hardness. The total prescribes one sort or two sorts or more of content of these elements to 0.01 - 1wt% in order for electric conductivity and hot working nature to fall remarkably, if the effect is not fully acquired but exceeds [less than / 0.01wt%] 1wt%. Moreover, as for the content of P, it is desirable to consider it as 0.005 in all to 0.5 wt% at these.

[0017] In the copper alloy concerning the 2nd invention, Pb, Bi, Se, Te, Ca, Sr, and a misch metal contribute to improvement in punching quality. The Reason for specifying one sort or two sorts or more of content of these elements to 0.001 - 0.5wt% by the total is for hot working nature to fall less than [0.001wt%], if the addition effect is not fully acquired but exceeds 0.5wt%.

[0018] In the copper alloy concerning this invention, In, Ba, Sb, Hf, Be, Nb, Pd, B, C, etc. are mentioned as an alloying element effective in the hardness of lead frame material or terminal material, and heat-resistant improvement. As for the amount of addition, it is desirable that it is the range in which electric conductivity is not reduced sharply, for example, 0.001 - 1wt%.

[0019] Moreover, if the content of O and S which are mixed at the time of dissolution casting shall be 50 ppm or less, surface properties, such as metal-plating nature, soldered joint nature, and solder leakage nature, can be held good.

[0020]

[Example] Next, the work example of this invention is shown and it explains more concretely about this invention.

(Work example 1) 16 sorts of alloys (No.1-16) of the presentation shown in the following table 1 were dissolved with the high frequency fusion furnace, this was cast in the cooling rate of 6 degrees C/second,

and the ingot 30mm in thickness, 100mm in width, and 150mm in length was obtained. This ingot was hot-rolled at 850 degrees C, and it was made 12-mm-thick hot-rolling material. Next, double-sided facing of this hot-rolling material was carried out to 9mm in thickness, and the oxide film was removed, and subsequently to 1.2mm in thickness, after cold-rolling, it annealed at 530 degrees C in inert gas atmosphere for 1 hour. Then, after cold-rolling in thickness of 0.21mm, it annealed at 530 degrees C in inert gas for 1 hour, and further, finish rolling was carried out to the 0.15-mm-thick plate, and 16 sorts of plate samples were obtained.

[0021]

[Table 1]

表 1

分類	No.	Zn (wt%)	Sn (wt%)	P (wt%)	第一群添加元素 (wt%)	第二群添加元素 (wt%)	結晶粒度 (μm)
本発明例	1	6	0.2	0.05	Co 0.18	—	15
	2	5	1.7	0.19	Ti 0.19, Zr 0.30	—	10
	3	9	0.4	0.43	Si 0.21, Cr 0.24, Zr 0.37	—	15
	4	11	2.8	0.38	Co 0.74, Cr 0.05	—	10
	5	10	1.4	0.24	Si 0.58	—	15
	6	10	0.7	0.05	Al 0.02, Mn 0.22	—	10
	7	19	1.1	0.19	Zr 0.45	—	5
	8	19	1.9	0.25	Ti 0.28, Mg 0.33	—	15
	9	28	2.3	0.17	Cr 0.27, Zr 0.15	—	10
	10	28	1.6	0.08	Mn 0.17	—	10
	11	34	1.7	0.04	Al 0.09	—	10
	12	5	1.4	0.11	Mg 0.38	Pb 0.04, Bi 0.01	15
	13	9	2.1	0.24	Cr 0.93	Pb 0.02	15
	14	16	0.8	0.09	Co 0.21	Bi 0.03, Ca 0.005, Mm 0.41	20
	15	21	0.5	0.14	Si 0.08, Mn 0.14	Sr 0.18	10
	16	30	2.8	0.007	Ti 0.03	Se 0.08, Te 0.21	10

[0022] (Comparative example 1) Nine sorts of alloys (No.17-25) of the presentation shown in the following table 2 were processed into the plate by the same method as a work example 1.

[0023] (Comparative example 2) Two sorts of alloys (No.26, 27) of the presentation shown in the following table 2 were processed into the plate by the same method as a work example 1 except annealing conditions.

[0024] (Conventional example) The alloy (No.28) of the presentation shown in the following table 2 was processed into the plate by the same method as a work example 1.

[0025]

[Table 2]

表 2

分類	No.	Zn (wt%)	Sn (wt%)	P (wt%)	第一群添加元素 (wt%)	第二群添加元素 (wt%)	結晶粒度 (μm)
比較例☆	17	3	0.3	0.01	Mg 0.03	—	15
	18	39	0.2	0.18	Cr 0.15, Co 0.26	—	20
	19	19	—	0.008	Si 0.02	Pb 0.03	25
	20	14	3.2	0.06	Al 0.15	—	10
	21	6	1.1	—	Mg 0.03	—	15
	22	20	2.4	0.57	Zr 0.25	Te 0.02	10
	23	8	0.3	0.05	—	Se 0.18, Mm 0.34	20
	24	19	1.6	0.44	Cr 0.44, Si 0.29, Mn 0.38	Bi 0.10	—
	25	5	2.7	0.05	Ti 0.12	Bi 0.18, Ca 0.39	—
	26	33	2.7	0.03	Si 0.06	—	<5
	27	24	1.4	0.06	Cr 0.15	—	40
従来例	28	21	—	—	—	—	20

(注) ☆ No. 17-25は比較例1、No. 26, 27は比較例2

[0026] About each plate sample obtained as mentioned above, (1) grain size number, (2) tensile strength (TS), (3) electric conductivity (EC), (4) bending nature, (5) punching quality, and stress-corrosion-cracking-proof [(6)] nature were investigated by the following method. The result is shown in the following table 3 and Table 4. In addition, in the following table, the element of the group with which the element of the group which consists of Si, Cr, Ti, Zr, Co, Mn, and aluminum and Mg consists of the first group alloying element, Pb, Bi, Se, Te, Ca, Sr, and a misch metal was described as the second group alloying element.

[0027] (1) Grain size number : the crystal structure was observed with the optical microscope (200 times), and it measured according to the intercept method of JIS-H0501.

(2) It measured according to tensile strength (TS):JIS-Z2241.

[0028] (3) It measured according to (electric conductivity EC):JIS-H0505.

(4) Bending nature : the plate was started in 10mm in width, and length of 50mm (a machine direction and a rolling direction are parallel), it bent to this, and W Bent, carried out and bent at 0.1mm in radius, and visual observation of the existence of the crack in a part was carried out with the 50-time-as many optical microscope as this. That from which ** and a crack produced that from which O and dry rough skin produced the thing without a crack and dry rough skin was estimated as x.

[0029] (5) Punching quality : the angle hole (1mm x 5mm) was made in the plate by the metal pattern made from SKD11, 20 samples were extracted from the punching part from the 5001st time to the 10000th time at random, and it asked for fracture part rate (a/b) x100% to thickness b of a sample. This fracture part rate (fracture surface ratio) is set to one of the standards of punching quality, and it is estimated precisely that punching quality is so good that this rate is large, and the yield of ****** is high, and it can be processed.

[0030] (6) Stress-corrosion-cracking-proof nature (SCC-proof nature) : the test piece for tensile test 8mm in width and 50mm in length (a machine direction and a rolling direction are parallel) was cut down from the plate, and this was exposed to the ammonia atmosphere based on JIS-C8306. It is 20 Kgf(s)/mm2 to the both ends of this sample. Constant stress was applied and the time to a fracture was measured.

[0031]

[Table 3]

表 3

分類	No.	TS (N/mm^2)	EC (%IACS)	曲げ加工性	破断面比率 (%)	耐SCC性 (破断時間H)	製造加工性
本発明例	1	522	49	○	55	>500	良好
	2	547	35	○	58	>500	良好
	3	524	31	○	55	>500	良好
	4	640	28	○	60	>500	良好
	5	573	28	○	57	>500	良好
	6	544	29	○	55	>500	良好
	7	580	27	○	60	>500	良好
	8	624	26	○	65	>500	良好
	9	695	25	○	66	>500	良好
	10	681	25	○	65	>500	良好
	11	721	23	○	67	>500	良好
	12	535	34	○	55	>500	良好
	13	565	32	○	56	>500	良好
	14	585	30	○	61	>500	良好
	15	621	27	○	62	>500	良好
	16	756	23	○	68	>500	良好

[0032]

[Table 4]

表 4

分類	No.	TS (N/mm^2)	EC (%IACS)	曲げ加工性	破断部割合 (%)	耐SCC性 (破断時間H)	製造加工性
比較例☆	17	433	51	○	41	>500	良好
	18	727	21	△	68	>500	冷延割れ
	19	474	28	○	44	27	良好
	20	620	19	△	62	>500	冷延割れ
	21	450	34	○	42	>500	良好
	22	692	26	△	66	>500	冷延割れ
	23	412	41	○	40	>500	良好
	24	熱延割れがひどく製造できず					
	25	549	28	○	58	>500	熱延割れ
	26	735	21	×	65	>500	良好
	27	671	25	×	65	>500	良好
従来例	28	460	34	○	35	3	良好

(注) ☆ No. 17-25 は比較例 1、No. 26, 27 は比較例 2

[0033] Each of sample No.1 of the example of this invention - 16 is excellent in all the characteristics so that

clearly from the above-mentioned tables 3 and 4. On the other hand, since sample No.17 of a comparative example had little Zn, Sn was not added sample No.19, P was not added sample No.21, and the first group alloying element was not added, tensile strength was all low and, as for sample No.23, punching quality got worse.

[0034] Moreover, since sample No.18 of a comparative example, and 20 and 24 had many Zn(s), Sn(s), or first group alloying elements, it was inferior to manufacture workability, and especially sample No.24 had the severe hot-rolling crack, and manufacture of them was not completed. Sample No.26 and 27 did not have proper annealing conditions, the grain size number became the outside of the value of standard of this invention, and bending nature fell. Moreover, in sample No.19 of a comparative example, or sample No.28 of the conventional example, since Sn is not added, SCC-proof nature is falling.

[0035]

[Effect of the Invention] As mentioned above, as stated in detail, it is the copper alloy for semiconductor lead frames of this invention, While using Cu-Zn alloy excellent in punching quality as a base and adding a proper quantity of Sn(s), P, etc. to this A grain size number is controlled, stress-corrosion-cracking-proof nature etc. is improved, it excels in hardness, conductivity, bending nature, punching quality, stress-corrosion-cracking-proof nature, manufacture workability, etc., and a prominent effect is done so on industry.

[Translation done.]